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Application Serial No. 10/578,390
Reply to office action of November 19, 2009PATENT
Docket: CU-4805Amendments To The Claims

The listing of claims presented below will replace all prior versions, and listings, of claims in the application.

Listing of claims:

1. (currently amended) A garbage data collection method performed during a communication cycle of a plurality of communication cycles of a computing device having memory including writeable non-volatile memory, the garbage data collection method comprising:

performing a mark phase during a communication cycle, the mark phase for making a first list, the first list being an address list including addresses of objects to be deleted from the entire writeable non-volatile memory space the memory;

performing a first sweep phase during the communication cycle ~~for deleting the listed objects of to delete objects listed in~~ the first list from the memory, wherein the performing of the sweep phase comprises:

calculating a residual time up to a predetermined time limit after processing an external command;

after calculating the residual time, deleting ~~the listed objects listed in the~~ of the first list from the memory during within the calculated residual time; and

updating the first list ~~of objects to list those undeleted to include~~ addresses of remaining objects listed in the of the first list of objects to be deleted which cannot be deleted within remain after the lapse of the calculated residual time, and storing the updated first list in the memory separately from the objects so as to prevent deletion of the first list.
memory and wherein,

~~If objects to be deleted remain after performing the mark phase and the first sweep phase during the communication cycle, performing only a sweep phase during subsequent communication cycles until all the objects of the first list are deleted from the memory.~~

2. (previously presented) The method of claim 1, wherein the time limit is

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determined by a host that transmits the external command or the time limit is determined to be a period of time up to a time guaranteeing QoS that a user does not feel a response delay to the external command.

3. (previously presented) The method of claim 1, wherein the act of making the first list is performed when a garbage collection is requested or when a communication session for receiving the external command is initialized.

4. (currently amended) The method of claim 1, wherein the act of making the list of objects comprises:

adding to the first list an address of an object that was to be deleted any object earmarked for deletion in a prior communication cycle but remains remaining in the memory undeleted.

5. (currently amended) The method of claim 1, wherein the act of making the list of the objects comprises:

updating the first list of objects when an object is newly generated or deleted during the command processing.

6. (currently amended) The method of claim 1, wherein the act of deleting the objects of the first list comprises:

making a second list including addresses of objects to be deleted from the memory during any residual time remaining after deleting all objects listed in the first list.

7. (currently amended) The method of claim 1, further comprising:

during the communication cycle, deleting objects listed on or an existing list of objects listing which remain undeleted after objects of a prior communication cycle before the external command is processed.

8. (currently amended) The method of claim 1, further comprising:

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if the command includes a memory write command or an object delete command, and if there is a list including addresses of objects to be deleted from the memory before the write or delete command is processed, performing the deleting of the objects together with the write or delete command.

9. (currently amended) The method of claim 1, wherein the deleting of [[the]] listed objects comprises:

if the objects listed in the first list exist in the memory in a consecutive order, deleting the consecutively ordered objects all together, and if a memory space to be allocated for an object and a memory space of the objects listed in the first list are consecutively ordered memory spaces or the same memory space, performing the acts of allocating and deleting together.

10. (currently amended) A garbage collection apparatus comprising:

a timer, which calculates a residual time up to a predetermined time limit after processing an external command; and

a memory management unit, which performs a mark phase during a communication cycle, the mark phase for making a list including addresses of objects to be deleted from ~~an entire writeable non-volatile memory space a memory~~, and performs a first sweep phase during the communication cycle for deleting ~~the listed~~ objects listed on the of the first list from the memory, wherein the sweep phase comprises deleting ~~the listed~~ objects listed on the of the list from the memory during within the calculated residual time, updating the list to include addresses of remaining objects listed in the list of objects which cannot be deleted within to list these undeleted objects of the first list after the lapse of the calculated residual time, and storing the updated first list in memory separately from the objects so as to prevent deletion of the first list. memory, and wherein, if objects to be deleted remain after performing the mark phase and the first sweep phase during the communication cycle, performing only a sweep phase during subsequent communication cycles until all the objects of the first list are deleted from the memory.

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11. (currently amended) The apparatus of claim 10, wherein the memory management unit deletes objects listed on an of-an existing list which includes addresses of objects which remain listing undeleted after objects of a prior communication cycle before the external command is processed.

12. (currently amended) The apparatus of claim 10, wherein the memory management unit, if the command includes a memory write command or an object delete command, and if there is a list including addresses of objects to be deleted from the memory before the write or delete command is processed, performs the deletion of the objects together with the write or delete command.

13. (currently amended) A computer readable medium having recorded thereon a computer readable program for performing a garbage data collection method performed during a communication cycle of a plurality of communication cycles of a computing device having memory including writeable non-volatile memory, the garbage data collection method comprising:

performing a mark phase during a communication cycle, the mark phase for making a first list, the first list being an address list including addresses of objects to be deleted from ~~the entire writeable non-volatile memory space the memory~~;

performing a first sweep phase during the communication cycle ~~for deleting the listed objects of to delete objects listed in~~ the first list from the memory, wherein the performing of the sweep phase comprises:

calculating a residual time up to a predetermined time limit after processing an external command;

after calculating the residual time, deleting ~~the listed objects of the objects listed in the~~ first list from the memory within the calculated residual time; and

updating the first list ~~of objects of those undeleted to include addresses of remaining objects listed in the of the first list which cannot be deleted within after the lapse of~~ the calculated residual time, and storing the updated first list in the

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memory separately from the objects so as to prevent deletion of the first list.
~~and wherein, if the objects to be deleted remain after performing the mark phase and the first sweep phase during the communication cycle, performing only a sweep phase during subsequent communication cycles until all the objects of the first list are deleted from the memory.~~